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DISEASES OF PLUMS

AND THEIR CONTROL

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DIVISION OF BOTANY AND PLANT PATHOLOGY
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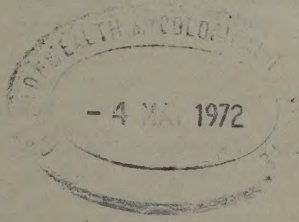

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Diseases of Plums and Their Control*

By G. H. Berkeley, M.A., Ph.D.

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Plums, like other tree fruits, are subject to various diseases which, under certain conditions, may cause considerable damage. In the following pages, the symptoms of some of the more common diseases of plums are described and control measures are outlined. To obtain good results in controlling plum diseases, practise the sanitary and cultural measures recommended, as well as the spray schedule. Both are essential to good control. In other words, plant diseases can be controlled, but they must be fought squarely, by marshalling against their attack all the preventive measures known to-day to be of value in checking their spread.

Black Knot. (*Dibotryon morbosum* (Schw.) Theiss. & Syd.)

This is not only the most common and conspicuous disease of wild and cultivated plums in Canada, but also one of the most destructive. It also attacks the cherry, but is usually not as severe on the cherry as it is on the plum. In neglected orchards this disease will, in a very short time, so adversely affect and devitalize the trees that they become useless. The distinctive symptom of this disease, as its name implies, is the black knot or gall formed on the woody parts of the tree. These knots, though mainly found on the twigs and smaller branches, may, however, be found on the trunks of large trees. The knots are first found as swellings in the late fall, or, more commonly in the early spring after growth starts. As growth continues the swellings crack open and a yellowish-brown granular growth fills the crevices. As the season advances the swelling increases and the irregular knot-like growth becomes more pronounced. Shortly after the granular growth in the crevices appears the surface of the knot is covered with a light green, velvet-like pile. On this surface are the summer spores of the fungus. Towards fall, the knot becomes darker and goes into the winter condition perfectly black. In the following spring, the black knot gives rise to another spore form which initiates the disease that spring. Although spores are being given off during the summer, till towards fall, and again early the following spring, the critical period for infection is during April to June. When the spores alight on a tender branch and find conditions favourable for germination and growth, infection may take place. When the fungus has once gained an entrance into the plum tree it develops and grows, until finally a black knot results. Though new knots are formed in this manner, it should also be realized that old knots may continue to increase in size each year, until in some cases they may become over a foot in length. Of course, some of these extra large knots are really the final result of two or more small ones growing together.

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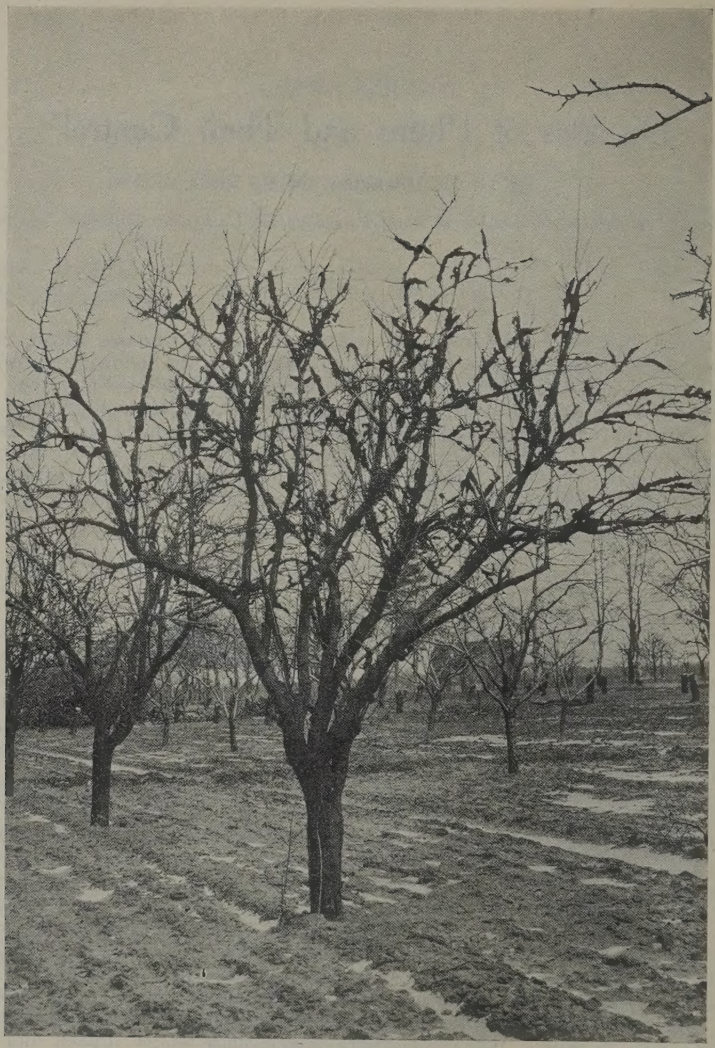

FIG. 1.—The result of neglect of black knot control measures on Lombard plum tree.

CONTROL

It should be clearly understood that control measures are based upon the following facts in the life cycle of the fungus responsible for "black knot":—

(1) that the fungus is perennial in diseased branches and extends beyond the limits of the knots.

(2) that conidia—the summer spores of the fungus—are mature and ready for infection when the knot shows a velvety olive green pile.

(3) that ascospores—the early spring spores—mature early in the spring just before growth starts.

(4) that the brush-pile of knot cuttings will produce black knot spores.
(5) that the spores are wind-borne.
(6) that the critical period for infection is from April to June.

With these facts as a basis it is readily understood why the following control measures are recommended:—

1. All knots should be cut out by the middle of February, and all branches bearing such knots should be cut back at least four inches beyond the external swelling of the knot. In orchards where this disease is prevalent it is advisable to follow the ordinary early spring pruning with a later inspection to remove any knots missed during the first pruning operations. All cuttings should be burned as soon as the pruning operations are complete. Experience has demonstrated that, if the prunings are left on the ground for any considerable length of time, the knots will sporulate just as though they had been left on the tree.

2. Although the cutting out of knots is essential in controlling this disease, the dormant and shuck sprays as a further aid to permanent control are of great importance. The dormant spray should be lime sulphur 1-7, or a 3 per cent oil emulsion in Bordeaux 3-6-40, and should be applied before the buds burst. For the shucks application 1-40 lime sulphur should be used and it should be applied when most of the shucks are off. It may be necessary to make an additional application of lime sulphur 1-50 just prior to opening of the blossoms, or during the full bloom stage, in those orchards where black knot is unusually severe and is difficult to control. Generally, however, the dormant and shuck sprays are sufficient to control this disease.

3. It is also well to remember that the spores of this disease are carried by the wind and that therefore if there are any wild plums, or neglected orchards in the vicinity of your orchard, it is only to be expected that your problem will be considerably more difficult due to the constant infections coming from such neglected trees. It is therefore advisable to cut and destroy all wild plum trees from the vicinity of your orchard. In districts where this disease is very severe, it will be necessary for a community effort to be undertaken in order to control the disease. Otherwise, it is extremely difficult for an individual grower to keep his orchard clean while nearby orchards are allowed to remain diseased.

Brown Rot. (*Sclerotinia fructicola* (Wint.) Rehm.)

Brown rot is a disease which attacks all stone fruits, that is, cherries, peaches and plums. It attacks the blossoms, causing a blossom blight; the twigs, causing a twig blight; the branches, causing cankers; and the fruit, causing a rot. It makes its first appearance each year at blossoming time, in the form of the so-called blossom blight. Blossom blight is very prevalent in those seasons when humid, wet conditions prevail previous to, or during the blossom period. The disease, as a rule, does not manifest itself again until the fruit nears maturity, when small brown spots may be noticeable on the skin of the fruit. As the disease progresses, these spots enlarge, become soft, and give rise to the common brown rot which is so disastrous to stone fruits. In a few days the whole fruit is involved and greyish tufts appear on the surface of the fruit. These tufts are the spores or seeds of the fungus and are carried by the wind to near-by fruit. Often these diseased fruits dry up, hang on the tree, and form the so-called "mummies" that are so common and conspicuous during the winter time, on plum trees that were badly infected with brown rot during the previous season. Mummies which hang on the tree give rise to spores the following spring. Also, at that time, a different type of spore, the so-called ascospore, is produced within brown coloured fungous bodies arising from the old mummied fruit on the ground, and these are dispersed at about the time the plums come into blossom. It has been shown, however, that if a mummy is covered by two inches of soil, it is not likely to sporulate the following spring and this fact is

made good use of from the standpoint of control and is the basis for the recommendation that all plum orchards should be ploughed in the spring in order to bury any mummies that may be lying on the ground, partially covered. Of perhaps equal importance is constant harrowing, disking, etc., early in the spring, previous to the blossom period in order to so disturb the mummies near the surface of the ground that their chances of sporulating are greatly decreased.

FIG. 2.—Brown rot on plum. Fruit reduced to mummies.

CONTROL

Experience has demonstrated that brown rot is by no means an easy disease to control. Since all parts of the tree may be attacked at one time or another, protection by spraying must be thorough. Also since there are so many sources of infection, such as (1) summer spores from (*a*) blighted blossoms, (*b*) blighted twigs, (*c*) hanging mummies, (*d*) cankers, and (2) ascospores (early spring spores) from fallen mummies, it is essential that the sanitary measures as given below should be put into practice.

(*a*) SANITARY MEASURES.—These are aimed at destroying the source of spore production and thus lessening the amount of spore material which may cause infection. In this way, less spore material should mean simplified control.

1. In pruning, remove and destroy all blighted twigs and cankers where possible.

2. Destroy all mummied fruit during harvest or shortly thereafter. Some growers make a practice of raking up and burning all mummied fruit. This is a laborious undertaking in a large orchard, but nevertheless is to be recommended.

(*b*) Cultural Practices.—1. Ploughing and repeated harrowing are of great value in brown rot control as they tend to prevent the formation of ascospores by so disturbing the mummies that they are unable to produce spores.

2. Trees with open heads have better air drainage, and hence are not so subject to brown rot as close headed trees. It is, therefore, advisable to open up trees with dense heads.

3. Thinning of heavily loaded trees, particularly of varieties subject to rot, is also recommended.

(*c*) Spraying.—Although the sanitary measures and cultural practices already described are essentials in control, the matter of spraying is the prime essential and should be a regular yearly practice. The first spray should be applied when the shucks are shedding; the second about two weeks later and the third application should be applied about ten days to two weeks before picking. Lime sulphur 1-40 should be used for the first two applications and a 1-50 strength for the third. Sulphur dust may be used in place of lime sulphur for the third application. In orchards where the blossom blight phase of this disease is usually severe, a spray of lime sulphur 1-50 should be applied just before blossoming.

Plum Pockets. (*Taphrina Pruni* (Fuck.) Tul.)

While this disease does not, as a rule, do very great damage in Canada, there are cases on record where the losses have been quite severe. In Nova Scotia it is sometimes severe, especially on Japanese varieties; frequent cases have been reported where trees have shed their entire set of fruit. It is the fruit which is chiefly affected, but young branches and leaves may also be attacked. The disease makes its first appearance in the spring soon after the petals fall, when infected fruit becomes a pale yellow, to red colour. Later the surface becomes covered with a greyish powder, the spores of the fungus, and the fruit becomes hollow. In the final stage the fruit becomes black, hard and brittle.

Affected branches and leaves often become much distorted, and small grey masses of spores, similar to those on the fruit, occur on the affected parts. Diseased branches should be especially watched for and destroyed, as they play an important part in the spread of the disease. This trouble is caused by a fungus very closely related to that causing peach leaf curl. The fungus spends the winter in the dormant stage in the diseased branches. As the warm weather of spring approaches, activity and growth are renewed and the fungus penetrates the young ovary of the developing fruit, causing the swelling and marked distortion spoken of above.

CONTROL

In Nova Scotia it has been found that a dormant spray, followed by a spray before the blossoms open, give excellent results in controlling this disease.* The dormant spray should be applied in the early spring, and preferably just before the buds start to swell. The dormant spray is essential in Nova Scotia for the control of this disease.

Shot Hole or Leaf Spot. (*Coccomyces prunophorae*) Higg.

Shot hole, leaf spot, or yellow leaf as it is sometimes called, is a very common disease on plums and cherries. In some seasons this disease is very severe, causing partial to almost complete defoliation. When the disease is so severe that partial or complete defoliation takes place, the trees produce no crop to

* Schedule recommended by Mr. J. F. Hockey, Plant Pathologist, Kentville, Nova Scotia.

speak of, and are considerably weakened for the following year. If, by any chance, the intervening winter is an unusually severe one such weakened trees are more subject to injury than they otherwise would be. This disease is manifest mainly on the leaves, although the fruit, fruit pedicels and leaf pedicels may also be affected. Early in June, or later, affected leaves show slightly discoloured, dark blue areas on the surface. These later become reddish brown in colour and as the disease progresses the leaf often turns yellow. The term "shot hole" has originated because of the fact that a large percentage of these diseased areas drop out, leaving holes in the leaf.

The term "yellow leaf" has been derived from the fact that in a good many cases infected leaves with spots, or sometimes without, become quite yellow. As stated above, when the infection is severe, partial or almost complete defoliation may result.

The fungus lives over the winter on diseased leaves that fall to the ground. In the spring a new crop of spores is produced, which initiates the disease. During the summer, spores are produced on the infected leaves.

CONTROL

Control is based on the destruction of old leaves and the protection of new leaves during the growing season. In practice, this is generally accomplished by spraying with lime sulphur 1-40, the first application being given when the petals have practically all fallen and the second should follow in two weeks' time. It is also advisable to have the over-wintered leaves ploughed under by cultivation previous to bloom.

Silver Leaf. (*Stereum purpureum* Fr.)

This disease, first recorded for the continent of America by Dr. H. T. Güssow, Dominion Botanist, is now known from Vancouver Island to Nova Scotia, but is not one of the major diseases, and in Canada is best known on apples, though it is primarily a disease of plums. In England, it has become a very serious menace to this fruit and recently very drastic legislation has been enacted to prevent its further spread.

The external signs of the disease are confined to the leaves. In the beginning, the trouble is usually confined to one branch, the leaves developing an unmistakable silvery or leaden sheen. This appearance is due to the formation of air spaces beneath the skin of the leaf, due to a splitting of the tissues in the interior of the leaf. Other branches become affected, some of the leaves often showing brown streaks and stains. Affected branches begin to die back, or sometimes the entire branch dies suddenly. At this stage the whole tree often becomes affected, all the leaves appearing silvered and death soon follows. The fruiting stage of the fungus later appears on the dead wood in the form of purplish crusts crowded together in irregular rows and it is from these that the spores are produced. The latter, being borne about by the wind, cause new infections, provided an entrance can be obtained through a wound.

CONTROL

Although a great deal of research has been carried out, no reliable cure has been found. The only means of control, therefore, is to take stringent measures against its spread. In slightly affected trees, cut off the branch affected below the point where the last brown stain appears in the wood; paint over the cut; and burn the pruned limb. Dead or dying trees should be completely uprooted and destroyed.

Bacterial Leaf Spot or Shot Hole. (*Bacterium Pruni* E.F.S.)

This disease, as its name indicates, manifests itself as a leaf spot, the final symptoms of which often result in "shot holes" due to the central portion of the spot falling out. In addition, however, twigs and fruit are also attacked. In some seasons in the Niagara Peninsula both the leaf and fruit spots are conspicuous and common, particularly on Japanese varieties, which are very susceptible, but the twig blight and canker phases, though present, are neither common nor important. On the leaves the spots are black and somewhat larger than on the fruit. The spots on the fruit are black with a depressed centre and purple margin. Cracks commonly develop in the affected tissue.

CONTROL

Spraying for this disease has not given satisfactory results, though the standard spray schedule for plums is of some assistance in this connection. It has been found, however, that proper pruning, cultivation and fertilization go a long way in preventing attacks of bacterial leaf spot since trees in good growing condition are more resistant. It is held that trees with an adequate amount of nitrate do not defoliate. It is advisable, therefore, to ensure that the orchard is in a good state of fertility.

Little Plum (*A virus disease*)

Though this disease is present in Ontario on plums it is by no means widespread or serious. Peaches are also attacked by this same disease, in which case the disease is known as little peach. Little peach is much more common and serious on peaches than is little plum on plums. The symptoms of little plum, as its name implies, consist of fruit that is smaller in size and which matures from 7 days to 2 weeks later than normal fruit. The leaves are small, inclined to droop and curl, and are "off colour."

CONTROL

Control, as in the case of peaches, consists in taking out and burning all affected trees.

Winter Injury

Winter injury of plum trees may take any one of several different forms such as (1) Dieback of twigs; (2) Killing of blossom buds; (3) Root and Crown injury; (4) Frost browning and Blackheart; and (5) Sunscald.

(1) *Dieback.*—Trees which, for one reason or another go into the dormant state with immature wood, may fall a prey to dieback, that is killing back of the twigs. Such twigs generally become attacked by weak parasitic fungi such as *Cytospora, Valsa, Nectria,* etc.

(2) *Blossom buds.*—Buds may be killed by unusually low temperature during normal dormancy, or, as is more general by early December freezes while the buds are not sufficiently hardened, or by later freezes following unseasonably warm weather which has started the buds into activity.

(3) *Root and Crown injury.*—This type of injury is quite common with the plum. The term root injury refers to injury of the roots, whereas crown injury refers to the injury at, or near the surface of the ground, often involving the roots near the surface as well.

(4) *Frost browning and blackheart.*—Severe frost often has the effect of turning the entire heart wood of a tree a dark brown to black colour. Whether or not this condition adversely affects the tree depends upon its severity. In many cases the tree does not seem to be injured to any appreciable extent. On the other hand, trees that have been killed outright during the dormant period often show this decided browning.

(5) *Sunscald.*—This type of injury is quite common and often severe. It is found on the limbs and trunk and on the south or southwest side of the tree. The trouble is apparently caused by severe frost following bright, warm sunshine.

CAUSE

All the above forms of winter injury are not necessarily due to cold alone. Plant tissue under normal conditions is able to withstand very low temperatures. However, when trees go into the dormant period with tissues immature, they are apt to be affected with some form of winter injury. The grower should, therefore, endeavour to keep his trees from growing too rapidly or too late. The following factors may be mentioned as some of the more important causes contributing to winter injury:—

1. Wet feet, or too much water in the soil, due to lack of drainage or excessive rainfall, or both. Tile underdrainage is, of course, strongly recommended to overcome poor drainage.

2. Late cultivation which tends to force late growth and hence produce immature tissue.

3. Wood which for any reason is not sufficiently "hardened" is particularly susceptible to rapid and unusual changes in temperature at the approach of the dormant period.

4. Severe pruning which is apt to stimulate late growth.

5. Low vitality of the tree. This may be caused by many factors such as impoverished soil, incorrect cultivation, partial or complete defoliation by fungi or insects and any other factor or factors which produce abnormal growth conditions.

6. Late applications of growth producing fertilizers.

PREVENTION AND TREATMENT

(*a*) Prevention.—The following suggestions may be of value in this connection:—

1. The soil should be well drained. The orchard should have good natural drainage. If not, then a system of underdraining is to be recommended.

2. In choosing the site of a new orchard, keep uppermost in mind the matter of soil and air drainage. Orchards in low-lying, insufficiently drained land will not do well.

3. Avoid late cultivation.

4. Be sure that plenty of plant food is present in the soil. If not, add humus by way of manure or cover crops. The addition of commercial fertilizers is often to be recommended.

5. Cover crops are also of advantage in hardening up the wood in that they tend to stop late growth.

6. Prevent defoliation by insects or fungi by strictly adhering to the spray schedule recommended.

(*b*) Treatment.—In the case of sunscald, and more particularly collar rot, treatment is often advisable. If a rot has started, cut away the diseased tissue until healthy tissue is exposed. Disinfect with corrosive sublimate and leave the wound exposed to the sun's rays for a week or so at least. Then paint with coal tar or wood asphalt compound.

Where the rot completely girdles the trunk, bridge-grafting may be advisable.

Where limbs are sunscalded, or twigs killed, it is advisable to cut them out as soon as possible, provided the branches are not skeletal branches, which, if removed, would spoil the tree. If such limbs near the trunk are rotted, they should be treated as described above.

SPRAY SCHEDULE FOR PLUMS

The following spray schedule, accompanied by good sanitary and cultural practices as recommended, should give satisfactory commercial control of the foregoing diseases.

1. Dormant Spray.—To be applied early in the spring before, or as the buds are bursting. Use lime sulphur, one gallon of commercial lime sulphur to seven gallons water, or a 3 per cent oil emulsion in 3-6-40 Bordeaux. This spray is essential for black knot and plum pockets. It also takes care of scale, red mite, etc.

2. Shuck Spray.—To be applied as soon as most of the shucks are off. Use lime sulphur, one gallon to 40 gallons water. It is advisable to add 1½ pounds of arsenate of lead or one pound of arsenate of lime and 3 pounds hydrated lime to the lime sulphur for this application to control curculio and other insects.

3. First Summer Spray.—Same material as shuck spray above. To be applied about 12 days later.

4. Pre-Pick Application.—Ten days to two weeks before the fruit is picked use lime sulphur 1-50; a pre-pick wettable sulphur; or dust with sulphur.

Additional Sprays.—In wet seasons additional applications may be necessary at two- or three-week intervals, particularly on varieties subject to rot.

Note.—On Japanese varieties, use a wettable sulphur or bentonite sulphur, in place of lime sulphur, following the dormant spray.

Caution.—Spraying to be of any value must be thorough. Apply plenty of spray so that all parts of the trees are covered with the spray material. Use a fine mist, with a pressure of 250 pounds or more, which must reach the top of the tree as well as the tips of all branches.

ADDITIONAL CONTROL MEASURES

In addition to the spraying schedule as outlined above, the following auxiliary measures should be adopted:—

1. Cut out and burn all black knots, cankers, blighted twigs and diseased branches. All knots, cankers, etc., must be removed and burned before growth starts in the spring.

2. Destroy all mummied fruit left hanging on the tree after harvest. These should also be burned before growth starts in the spring.

The practice of ploughing and harrowing just previous to blossoming is an aid in brown rot and leaf spot control, because if mummies and leaves are buried deep in the ground they are not so apt to sporulate.

STANDARD SPRAY MATERIALS AND DISINFECTANTS

Commercial Lime Sulphur.—This is readily obtainable on the market from various supply houses. It comes in two forms, liquid and dry, both of which have given good results. The liquid is in more general use, however.

THREE PER CENT OIL EMULSION IN BORDEAUX 3-6-40.—This material combines an insecticide (oil) with a fungicide (Bordeaux) and is used only for the dormant spray. The oil emulsion is made up as follows:—

Lubricating spray oil	3 gallons
Bluestone	6 ounces
Fresh hydrated lime	6 ounces
Water	3 gallons

The bluestone is dissolved in one-half the water and the hydrated lime stirred into the remainder, then mixed together and poured into the oil. The entire mixture is then pumped through the machine until an emulsion is obtained which is added to the Bordeaux ($7\frac{1}{2}$ pounds copper sulphate, 15 pounds hydrated lime, to 100 gallons water). After the oil emulsion and Bordeaux have been mixed pump this mixture through the gun, back into the tank, so as to replace the oil emulsion in the pump and hose, with the oil emulsion-Bordeaux mixture.

WETTABLE, BENTONITE AND PRE-PICK SULPHURS.—These are commercial products. Follow the directions on the package. Only these forms of sulphur should be used on Japanese plums.

CORROSIVE SUBLIMATE.—This is a mercuric poison used as disinfectant in canker treatment. This is generally obtained in tablet or powder form. The standard strength used is 1-1000. A tablet in a pint of water, or 1 ounce of the powder in 6 gallons water gives this strength.

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